

Hip and Groin Injuries in National Collegiate Athletic Association Women's Soccer Players

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Background: Hip and groin injuries are common in competitive soccer players and have been shown to be significant sources of time loss. There are few studies describing the epidemiology of hip and groin injuries in female National Collegiate Athletic Association (NCAA) soccer players.

Purpose: To describe the epidemiology of hip and groin injuries in women's collegiate soccer players.

Study Design: Descriptive epidemiology study.

Methods: The NCAA Injury Surveillance System/Program (ISS/ISP) was analyzed from 2004 through 2014 for data related to hip and groin injuries in female collegiate soccer players. Injuries and athlete-exposures (AEs) were reported by athletic trainers. Data were stratified by time of season, event type, injury type, treatment outcome, time loss, and player field position.

Results: Between 2004 and 2014, there were 439 recorded hip or groin injuries in female soccer players and an overall rate of injury of 0.57 per 1000 AEs. Injuries were 12.0 times more likely to occur during the preseason (4.41/1000 AEs) as opposed to during the regular season (0.37/1000 AEs) (injury rate ratio [IRR], 12.01; 95% confidence interval [CI], 9.92-14.55) or postseason (0.38/1000 AEs) (IRR, 11.55; 95% CI, 7.06-18.91). Rates of injury were similar during the regular season and postseason (IRR, 0.96; 95% CI, 0.59-1.58). Rates of injury were higher during competition (0.69/1000 AEs) than during practice (0.52/1000 AEs) (IRR, 1.33; 95% CI, 1.08-1.63). Most injuries were new (87.5%; n = 384) and unlikely to recur (12.5%; n = 55).

Conclusion: Hip and groin injuries in female NCAA soccer players are uncommon, and fortunately, most players return to play quickly without recurrence. Future prospective studies should evaluate the effectiveness of strength and conditioning programs in preventing these injuries.

Keywords: hip; groin; NCAA; soccer; women; injuries; return to play; strength and conditioning

Soccer is one of the world's most popular sports, with an estimated 4% of the world's population participating.⁷ The Fédération Internationale de Football Association (FIFA) reported in 2007 that there were 265 million soccer players worldwide, of which women made up over 25 million.⁷ In the United States alone, 25 million players are registered with the United States Soccer Federation.⁷ The collegiate soccer athlete represents a highly skilled subset of this population. During the 2017-2018 National Collegiate Athletic Association (NCAA) season, 27,811 women from 1038 teams participated in collegiate soccer.¹⁰

Hip and groin injuries are common in both male and female soccer players. This may be attributable to the quick acceleration, abrupt turning and cutting, and muscle loads while kicking that are inherent in game play.^{4-6,31} Although

professional male soccer players have a higher rate of groin injuries compared with professional female players,^{6,19,22,25} female soccer players still experience a high rate of hip and groin injuries.^{12,15,16} Of all injuries sustained by female collegiate soccer players, hip and groin injuries have previously been shown to account for approximately 5.1% of injuries sustained during competition and 10.0% of injuries that occur in practice and are a source of increased time lost from sport.²³

Differences in the injury type between sexes have been observed. Eckard et al⁶ analyzed hip flexor and adductor strains in NCAA athletes between 2009 and 2015 and found that rates of hip flexor strain did not differ between sexes but that hip adductor strains were more common in men than women. It has previously been noted that the most common location for injuries for both male and female professional athletes with chronic hip pain is the hip joint, although this accounts for a much greater proportion of hip and groin injuries in female than male athletes: 77% versus

45%, respectively.²² While it appears that men have a higher rate of hip/groin injuries during competition, women have similar rates of groin injuries during practice.¹⁹

Although several epidemiological studies^{2,3,24,25,32} describing the types and rates of hip injuries have been performed, these have mostly been in professional soccer players and in men. The purpose of this study was to better characterize the specific types of hip and groin injuries that are common in female collegiate soccer players. This will allow more targeted strength and conditioning programs aimed at preventing these injuries. Furthermore, by understanding when these injuries occur (preseason, regular season, postseason; practice vs competition), it will further help implement preventive strategies and decrease the incidence of such injuries.

METHODS

This study was approved by the research review board of the NCAA. Data from the NCAA Injury Surveillance System/Program (ISS/ISP) for a 10-year period between 2004 and 2014 were analyzed. Data were collected over two 5-year periods: 2004-2009 and 2009-2014. The data from the 2 periods were combined into a single data set, and injuries that had been recoded or renamed between the data sets were grouped into the same injury type as appropriate. A similar study³⁰ was conducted in male collegiate athletes using this same methodology.

The NCAA ISS/ISP data collection methodology has been well described.¹³ The NCAA ISS/ISP data rely on convenience sampling of teams and athletic trainers (ATs) voluntarily reporting injuries and athlete-exposures (AEs). These data are entered by the ATs into an online database, which included an average of 77 teams for 2004-2009 and 28 teams for 2009-2014.¹³ This variation in the number of teams can be accounted for by the voluntary nature of reporting to the online system.

Data were collected and entered into each participating institution's electronic health record by the ATs, who recorded injuries or events for varsity-level, organized competitions and practices during the preseason, regular season, and postseason. The ATs entered information such as circumstances surrounding the injury, anatomic location, injury type, and field position, among other data. AEs were also calculated using this system by counting the number of athletes participating in each competition or practice. Data

were deidentified in compliance with the Health Insurance Portability and Accountability Act (HIPAA).

Definitions

A "reportable injury" was defined by the NCAA ISS/ISP as any injury that (1) occurred as a result of participation in an organized NCAA practice or competition and (2) required attention or treatment from an AT or physician.¹³ Multiple injuries resulting from 1 injury event were included.¹³

An AE was defined as 1 student-athlete participating in 1 NCAA-sanctioned practice or competition in which he or she was exposed to the possibility of an athletic injury, regardless of the time associated with that participation.¹³ Athletes were included in competition exposures only if they had playing time in a competition.¹³ AEs were recorded during varsity-level, NCAA-sanctioned, and organized practices and competitions during the preseason, regular season, and postseason.¹³

Time loss was defined as the time between the date of original injury and return to a level of play that would allow competition participation.¹³ If no competition or practice was scheduled for the day after an injury event, the AT was requested to determine whether the athlete would have been able to participate.¹³ Time loss was reported in intervals (ie, 0-3, 4-6, 7-13, 14-29, ≥ 30 days).

Statistical Analysis

Hip injury rates and patterns were assessed and included injury type and location, mechanism of injury, injury recurrence, loss of playing time, player field position, time of season, and necessity of a surgical intervention. Injury rates were calculated using the specific injury count divided by the number of AEs and are reported as the number of injuries per 1000 AEs. The percentage of total injuries was calculated using the specific injury count divided by the total number of injuries. A comparison of injuries by exposure type (ie, practice vs competition, preseason vs regular season vs postseason) was accomplished by calculating injury rate ratios (IRRs). The IRR was calculated by dividing the injury rate for a specific exposure type by the injury rate for a different exposure type. An example of the IRR for preseason and regular-season injuries is as follows:

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Ethical approval was not sought for the present study.

TABLE 1
Time Loss

	n (%)
0-3 d	204 (46.5)
4-6 d	104 (23.7)
7-13 d	68 (15.5)
14-29 d	38 (8.7)
≥30 d	15 (3.4)
Unknown	10 (2.3)

$$IRR = \frac{\frac{\text{Number of preseason injuries}}{\text{Number of preseason AEs}}}{\frac{\text{Number of regular-season injuries}}{\text{Number of regular-season AEs}}}$$

Statistical significance was established by 95% confidence intervals (CIs), which were considered significant if they did not contain 1.0.

RESULTS

From 2004 to 2014, there were 439 hip or groin injuries recorded in female NCAA soccer players, with a total of 772,304 AEs. Overall, there were 0.57 injuries per 1000 AEs. Injuries were new ($n = 384$; 87.5%) and unlikely to be recurrent ($n = 55$; 12.5%). Very few injuries were chronic ($n = 20$; 4.6%), and less than 1% of injuries required surgery ($n = 3$; 0.7%). A majority of players lost less than 7 days ($n = 308$; 70.2%) (Table 1). Players tended to have injuries to the right hip ($n = 252$; 57.4%) rather than the left ($n = 174$; 39.6%).

Injuries by Time of Season

Hip or groin injuries were most likely to occur during the preseason ($n = 229$; 52.2%) as opposed to the regular season ($n = 193$; 44.0%) or postseason ($n = 17$; 3.9%). The rate of injury during the preseason was 4.41 injuries per 1000 AEs. This was significantly higher than the rate of injury in the regular season (0.37/1000 AEs) or postseason (0.38/1000 AEs). Athletes were 12.0 times more likely to have a hip injury in the preseason than the regular season (IRR, 12.01 [95% CI, 9.92-14.55]) and 11.6 times more likely to have an injury in the preseason than the postseason (IRR, 11.55 [95% CI, 7.06-18.91]). Although there were more injuries and more AEs during the regular season than the postseason, there was an almost equal rate of injury (IRR, 0.96 [95% CI, 0.59-1.58]).

Injuries by Event Type

There were a greater number of hip injuries during practice ($n = 307$; 69.9%) than during competition ($n = 132$; 30.1%). However, the rate of injury was higher during competition (0.69/1000 AEs) than during practice (0.52/1000 AEs). Female NCAA soccer players were 1.3 times more likely to have a hip or groin injury during competition than during practice (IRR, 1.33 [95% CI, 1.08-1.63]).

TABLE 2
Injuries by Type

	n (%)
All injuries	439 (100.0)
Adductor tear (partial or complete)	164 (37.4)
Iliopsoas/sartorius tear (partial or complete)	135 (30.8)
Hip contusion	54 (12.3)
Internal rotator (groin) tear (partial or complete)	34 (7.7)
Gluteus muscle partial tear	13 (3.0)
Greater trochanteric bursitis/snapping hip syndrome	9 (2.1)
External rotator (piriformis) tear (partial or complete)	8 (1.8)
Abductor muscle tear (partial or complete)	4 (0.9)
Hip impingement	4 (0.9)
Adductor tendinitis	3 (0.7)
Hip articular cartilage injury	3 (0.7)
Hip spasm	3 (0.7)
Adductor (groin) contusion	1 (0.2)
Hip avulsion fracture	1 (0.2)
Hip neuroma	1 (0.2)
Hernia (inguinal or femoral)	1 (0.2)
Hip subluxation	1 (0.2)

Activity and Mechanism of Injury

Women were most commonly injured during general play ($n = 192$; 43.7%), followed by conditioning ($n = 47$; 10.7%), goaltending ($n = 38$; 8.7%), shooting ($n = 33$; 7.5%), defending ($n = 24$; 5.5%), passing ($n = 19$; 4.3%), and running ($n = 19$; 4.3%). Acute, noncontact injuries accounted for a majority of hip and groin injuries ($n = 260$; 59.2%). Overuse/gradual onset ($n = 83$; 18.9%) and contact with other players ($n = 47$; 10.7%) followed in frequency.

Injuries by Position

Defenders were injured the most frequently ($n = 48$; 36.4%), followed by forwards ($n = 36$; 27.3%), midfielders ($n = 29$; 22.0%), and goalkeepers ($n = 10$; 7.6%). The position was unknown for 9 injuries (6.8%).

Injuries by Type

The most common injury for female soccer players was muscle tear ($n = 358$; 81.5%). This was followed by contusion ($n = 54$; 12.5%) and intra-articular injury ($n = 9$; 2.1%). The 3 most common specific injuries were partial or complete adductor tear ($n = 164$; 37.4%), partial or complete iliopsoas/sartorius tear ($n = 135$; 30.8%), and hip contusion ($n = 54$; 12.3%) (Table 2).

Adductor tears occurred most commonly as new injuries ($n = 142$; 86.6%), during the preseason ($n = 95$; 57.9%), and during practice ($n = 127$; 77.4%). The most common mechanism of injury for adductor tears was noncontact ($n = 127$; 77.4%), followed by overuse/gradual ($n = 21$; 12.8%). Adductor tears most frequently resulted in a time loss of 0 to 3 days ($n = 68$; 41.5%). Surgery was not required for any adductor injuries.

Most iliopsoas/sartorius tears occurred as new injuries ($n = 118$; 87.4%), during the preseason ($n = 86$; 63.7%), and

TABLE 3
Time Loss by Injury Type
for the Top 3 Most Frequent Hip/Groin Injuries

	n (%)
Adductor tear	
0-3 d	68 (41.5)
4-6 d	44 (26.8)
7-13 d	33 (20.1)
14-29 d	13 (7.9)
≥30 d	2 (1.2)
Iliopsoas/sartorius tear	
0-3 d	62 (45.9)
4-6 d	26 (19.3)
7-13 d	24 (17.8)
14-29 d	15 (11.1)
≥30 d	7 (5.2)
Hip contusion	
0-3 d	29 (53.7)
4-6 d	17 (31.4)
7-13 d	6 (11.1)
14-29 d	1 (1.9)
≥30 d	1 (1.9)

during practice ($n = 104$; 77.0%). Noncontact iliopsoas/sartorius tears were most common ($n = 89$; 65.9%) and resulted in a time loss of 0 to 3 days ($n = 62$; 45.9%). Surgery was not required for any iliopsoas/sartorius injury.

All reported hip contusions were new injuries ($n = 54$; 100.0%). A majority occurred during competition ($n = 41$; 75.9%) and during the regular season ($n = 45$; 83.3%). Contact with another player ($n = 39$; 72.2%) was the most common mechanism of injury, and time loss was most commonly 0 to 3 days ($n = 29$; 53.7%). Surgery was not required for any hip contusion. See Table 2 for injury types.

Time loss for adductor tears, iliopsoas/sartorius tears, and hip contusions was similar. The highest proportion of each of these injuries resulted in 0 to 3 days of time loss (41.5%, 45.9%, and 53.7%, respectively). All 3 injuries caused similar proportions of time loss of 4 to 6 days (26.8%, 19.3%, and 31.5%, respectively). Adductor tears resulted in the highest number of injuries with 7 to 13 days of time loss ($n = 33$; 20.1%). The highest number of injuries causing 14 to 29 days of time loss was from iliopsoas/sartorius tears ($n = 15$; 11.1%). The highest number of time-loss injuries of ≥30 days was for iliopsoas/sartorius injuries ($n = 7$; 5.2%) (Table 3).

DISCUSSION

Hip and groin injuries in female collegiate soccer players, although uncommon, can detract from athletic performance.³⁰ Our findings from the NCAA ISS/ISP show that these injuries occur at a rate of roughly 1 injury per 2000 AEs. Very few injuries required a surgical intervention (<1%). Approximately 70% of players with hip or groin injuries lost less than 7 days, indicating that the remaining 30% of injuries were more severe injuries resulting in longer

recovery times. Time loss for hip and groin injuries was similar to time loss for other injuries in women's NCAA soccer.⁵ For all NCAA athletes, a majority of iliopsoas/sartorius injuries and hip adductor injuries required less than 7 days of absence from activity (83.8% and 82.9%, respectively),⁶ indicating that hip injuries in female NCAA soccer players may have longer recovery times.

Injuries more commonly occurred during the preseason (52.2%) than the regular season (44.0%) or postseason (3.9%), and athletes were 12 times more likely to sustain a hip injury in the preseason than the regular season or postseason. After the preseason ended, the rates for hip and groin injury dropped significantly and were almost equivalent in the regular season and postseason. This finding is consistent with prior studies of hip and groin injuries in professional women's soccer,^{12,15,16} injury patterns in women's NCAA soccer,^{5,23} and hip and groin injury patterns in men's NCAA³⁰ and professional¹⁷ soccer. The higher injury rate during the preseason indicates that poor conditioning and strength may play a role in the cause of these injuries.^{1,8,30} In addition, Langhout et al¹⁷ have shown that players with existing or prior hip/groin injuries have decreased range of motion²⁸ and that players with prior injuries are more likely to be reinjured.¹² Previous studies have shown that comprehensive warm-up programs can decrease the total number of injuries, severe injuries, and overuse injuries in female soccer players²⁶ and that conditioning and strengthening programs may improve hip strength and lead to lower rates of injury.^{9,11,29} In their study on female NCAA soccer players, Ness et al¹⁸ identified that strengthening programs can improve both lower extremity balance and hip strength. While these studies are promising, strength and conditioning interventions are less frequently offered or implemented for female compared with male athletes.²⁷

These results are consistent with the types of injury sustained by female NCAA soccer players. Muscle tears, including tears of the adductor and iliopsoas/sartorius muscles, were the most common injuries (81.5%). These injuries were most frequently classified as noncontact and overuse injuries, occurred during practice, and were sustained during the preseason. Time loss greater than 7 days resulted from adductor tears 29.2% of the time and from iliopsoas/sartorius tears 34.1% of the time. This is just slightly higher than the overall proportion of injuries with time loss greater than 7 days (29.8%). This pattern aligns with the overall pattern of hip injuries in female NCAA soccer players, and the injured muscles are the same as those targeted in strengthening programs.^{11,18,20,26,29} More studies are needed to determine the relationship between strengthening programs and injury rates in female soccer players. Because of the relatively large proportion of these injuries causing time loss of greater than 7 days, there should be even more emphasis placed on prevention strategies.

While overall hip and groin injuries were more likely to occur during the preseason, hip contusions were more likely to occur during the regular season (83.3%) and during competition (75.9%). A total of 12.3% of injuries were contusions, and almost all of these injuries (96.3%) occurred

because of a player making contact with another player or a surface. Hip contusions resulted in time loss of greater than 7 days in 14.9% of these injuries, which was less than the overall proportion of injuries causing time loss greater than 7 days (29.8%). This is consistent with the literature,^{5,8,23} and it suggests that regular-season injuries are more likely to occur during a game and are associated with contact for all NCAA sports. Suggestions for reducing the number of contact injuries have previously been limited to the enforcement of game rules and regulations.^{1,8} In a study of female youth soccer players during the 2007 season, Soligard et al²⁶ showed that the incidence of acute contact injuries could be reduced by a training and conditioning program in addition to a reduced incidence of overuse and severe injuries. More studies should be conducted to determine if there is a relationship between conditioning programs and contact injuries to the hip. However, because of the smaller proportion of these injuries causing time loss greater than 7 days, this may be less of a priority than the prevention of muscle tears and strains.

Injury rates were higher in competition compared with practice regardless of the time of season, and female NCAA soccer players were 1.3 times more likely to be injured in competition than in practice. This proportion was smaller than that of male NCAA soccer players, who are 2.33 times more likely to have a hip or groin injury in competition than practice.³⁰ Higher injury rates during competition may be caused by the increased intensity of play and increased amount of contact. In a study of professional male soccer players, Rahnema et al²¹ found that players were more likely to be injured during the first 15 and last 15 minutes of play time, when game play is at its highest intensity.

Future Directions

Future research should use the data presented here to implement prospective randomized studies that will evaluate the effectiveness of conditioning and strengthening programs in preventing these serious injuries. In doing so, a better understanding of injury prevention can be developed. The ultimate goal of these studies is to minimize the number and severity of injuries in these athletes in the future.

Limitations

This study was limited by its use of convenience sampling of schools, which may not represent the full spectrum of injuries sustained by female NCAA athletes. Because of the voluntary nature of reporting, results may vary by year. Moreover, it is possible for regional biases in the data to affect overall generalizability, given the small sample size. There is the potential for injuries to be seen independently by physicians and not be included in the database. However, the database has previously been shown to have a capture rate of 88% of all injuries.¹⁴ Our results and conclusions are limited to the population being studied and may not be generalizable to other populations or levels of competition.

Perhaps the most significant limitation to the study is the quality of data reported by the NCAA ISS/ISP. Injuries

were diagnosed by ATs, who treated players without the benefit of a physician to evaluate the player. Injuries may or may not have had outside work-up and imaging studies to confirm the diagnosis. ATs enter the injury details without orthopaedic surgical training and may not always accurately capture the nature of the injury, its chronicity, or its mechanism. The ISS/ISP uses overlapping muscle groups that do not have the same physiological function (ie, iliopsoas/sartorius) or separate groups that may have similar physiological function (ie, gluteus and abductor). This affects the validity of the data as well as its usability in describing injury patterns in muscle groups. While these inherent limitations of the database do not invalidate the data, the reader must be aware that recovery times and other findings may be inherently biased because of the nature of the reporting system.

CONCLUSION

Hip and groin injuries in female NCAA soccer players are uncommon, and fortunately, most players return to play quickly without recurrence. Injury rates were highest during the preseason as opposed to the regular season or post-season and were higher during competition than practice. To our knowledge, there are few prevention programs that address hip and groin injuries in female soccer players. However, promising data exist to suggest that stretching, strengthening, and exercise programs may be beneficial in reducing the incidence of hip and groin injuries in female NCAA soccer players.^{9,11,26,29} Future prospective studies should evaluate the effectiveness of conditioning and strengthening programs in preventing these injuries.

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